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Management Strategy for Pronghorn (Antilocapra americana) in Saskatchewan

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Management Strategy for Pronghorn *(Antilocapra americana)* in Saskatchewan.

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Executive Summary

This document establishes a baseline for pronghorn population status, distribution, and management in Saskatchewan through a review of the scientific literature, summary and analysis of existing population data, and delineation of pronghorn meta-populations on an area specific basis.

A management-by-objective (MBO) approach was used to create a biological and ecological framework (Pronghorn Management Units (PMU)) to organize and summarize available data; to provide a structure from which long-term management of pronghorn can be developed on an area-specific (management unit) basis, and; to provide a foundation from which management prescriptions can be evaluated and adjusted in relation to population performance as new information is acquired (adaptive management).

Pronghorn are the only ungulate in Saskatchewan that is an obligate grassland/shrub-steppe species. Pronghorn in Saskatchewan are at the northern extent of their continental range and are therefore subject to the extremes of stochastic events at that latitude.

The 2007 provincial population was estimated to be 18,450 animals of which 87% (16,053) occurred in core pronghorn range (WMZs 2-13). The balance of the population occurred sporadically in fringe range (WMZs 1,14,15,18,19 and 23-27). The long-term, pre-hunt population objective is 21,600 pronghorn (18,500 in core range and 3,100 in fringe range). The long-term pre-hunt population structure objectives are 0.51adult males/female and 0.71 fawns/female (0.37 fawns/adult). Population monitoring efforts should focus on core range, as fringe population status is dependant on core populations for maintenance and is greatly impacted by winter severity occurring in this sub-optimal habitat.

A linked sex and age harvest strategy is recommended for this species, using an either-sex draw quota based on a maximum allocation of 15% of mature bucks, and consideration for population structure objectives.

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1.0 Introduction

The purpose of this document was to develop a comprehensive and planned pronghorn management system using a Management-by-Objective (MBO) approach (per Arsenault 1998, Arsenault 2000, Arsenault 2003, Strickland 2001). The MBO approach is intended to create a biological and ecological framework to guide long-term pronghorn management. This was accomplished by:

- Partitioning Saskatchewan pronghorn range into landscape-based population management units. These Pronghorn Management Units (PMUs) provide the spatial extent of area in which management efforts are directed.

- Establishing a baseline for pronghorn status and management through a review of the scientific literature, summary and analysis of existing population (density, structure) and harvest data by PMU, and assessment of the current status and past performance of each PMU (meta-population). To effectively manage for the consumptive use and protection of critical habitat, we must understand the specific ecological relationships of pronghorn with the ecosystem of which it is a part (Klein 2000).

- Defining clear long-term population goals and numerical objectives (ie. population density, population structure, sustainable harvest level) based on past meta-population performance and reasonable future expectations for each PMU.

To effectively manage a game species, its population dynamics must be thoroughly understood. Once we understand the historical population dynamics and establish long-term objectives, we are then positioned to monitor population status relative to the long-term objectives by PMU. This planned management system provides the foundation from which management prescriptions can be evaluated and adjusted (Adaptive Management).

This report attempts to place pronghorn management within the broader context of provincial objectives of ecosystem-based management, maintenance of biological diversity, and integrated/sustainable use of wildlife. This was accomplished by:

- Focusing on long-term population management with the objective of pronghorn conservation, without negatively affecting the ecological integrity and biological diversity of the habitats they occupy (i.e., conservation issues).

- Improving the scientific knowledge of pronghorn and their ecological requirements by reviewing the scientific literature, habitat, and population data in Saskatchewan and in relation to their continental range.

- Integrating scientific and local knowledge of pronghorn.

- Developing a management framework (Pronghorn Management Units) based on meta-population distribution (as determined through aerial survey data, landscape habitat mosaic assessment, harvest data, and local knowledge) and the ecological land classification presented by Acton et al. (1998), as well as guidance by SE's policy framework, corporate mandate, and legal obligations.

- Using the best available scientific and local knowledge as a foundation for decision-making.

1.1 General Description

1.1.1 Taxonomy

Pronghorn are members of the order Artiodactyla (cloven-hoofed ruminants). The paraxonic foot structure is diagnostic of the order (ie. plane of symmetry passes between digits three and four). The third and fourth digits bear the animal's weight, the first digit is missing in living members of this order, and the second and fifth digits (dew claws) are reduced in size (Nowak 1999, Vaughan 1985). Within the order, pronghorn are classified into the family Antilocapridae.

The unique characteristic of North American Antilocapridae is their distinctive deciduous keratinous horn sheaths, which cover laterally flattened bone cores (Nowak 1999), which is why pronghorn were placed in a family separate from other bovids (O'Gara and Janis 2004), and the absence of dew claws. The fossil record of *Antilocapra americana* (Ord 1818) is entirely North American (Vaughan 1995). The taxonomy of pronghorn into subspecies is under debate (Krausman et al. 2005, O'Gara and Janis 2004). The species is classified into 5 currently recognized subspecies based on differences in color, size and form (Krausman et al. 2005):

- *A.a. americana* represents over 90% of all pronghorn (Wilson and Ruff 1999). It occurs in the grasslands and shrub steppes of western Canada and the U.S. and is the primary resident subspecies in Saskatchewan.
- *A.a. mexicana* are found in north-central Mexico and southern Texas
- *A.a. peninsularis* occur in Baja California.
- *A.a, oregona* occur in Oregon.
- *A.a. sonoriensis* (Goldman 1945) (Sonoran pronghorn), is an endangered subspecies occurring in northwestern Sonora, Mexico and the extreme southern portion of Arizona.

This report will focus on *A.a. americana* (as defined by current taxonomy) residing in the Prairie ecozone (Acton et al. 1998) of Saskatchewan.

1.1.2 Physical Description

The pronghorn is a small ungulate with a stocky body, long slim legs, short neck, and relatively large head. Anatomical adaptations include: large side protruding eyes with exceptional wide-angle vision (comparable to human eyes using 8X binoculars), a keen sense of hearing and smell, and a large-capacity respiratory system (Kitchen 1974). Pronghorn are the fastest animal in the Western Hemisphere, capable of attaining speeds 100-110 km/hr in short 3-4 minute sprints, and maintaining speeds of 60 – 65 km/hr for distances of several kilometres (Banfield 1974, Nowak 1999, Wilson and Ruff 1999, Whitaker 1996).

Males and most females carry horns, but they are inconspicuous on females. This is the only animal that sheds its horns annually. Horn sheaths are generally cast in late October through early November. Male horn morphology is characterized by a curved tip and a prong pointing forward and upward, which is located mid way on the horn sheath. Male horns are usually about 25 cm long but can reach 51 cm. Female horns are rarely more than 12 cm long, seldom have a prong (Nowak 1999), and are generally shorter than the ears.

Pronghorn dental formula is $I^0/_3\ C^0/_1\ P^3/_3\ M^3/_3$ (x 2 sides) = 32 (Nowak 1999). Dentition is characterized by high-crowned (hypsodont) cheek teeth, which have cresentric ridges of enamel (Nowak 1999). The upper canines are missing (Banfield 1987). The two central lower incisors are replaced by 14-16 months; all molar teeth have erupted by age 2.5 (pronghorn grow only one set of molars); premolars are shed by 2.5 years and replaced with a permanent set by 3.5 years; by 4.5 years the lateral incisors and canine teeth are replaced with a permanent set (Dow and Wright 1962, Jensen 1998).

On average, adult males are generally 10% larger than adult females (Nowak 1999). Adult males range in weight from 42 to 63 kg and adult females from 41 to 50 kg (Banfield 1987, Wilson and Ruff 1999). Adult shoulder height, ranges from 81 to 104 cm (Nowak 1999).

The upper part of the adult pelage is reddish brown to tan, the neck has a black main, and the under parts, rump and two bands across the neck are white (Nowak 1999). Males have a characteristic black cheek patch which is evident from birth, and which is lacking in females. The pelage consists of a wooly undercoat overlaid with longer, straight, coarse, hollow guard hairs. By flexing certain muscles, the pelage can be maintained at different angles to regulate skin temperature (Nowak 1999). Both sexes have a rosette of white erectile hairs on the rump (Whitaker 1996), which can be exposed as an alarm signal to other pronghorns. Fawn pelage is grayish but by 3 months of age it is replaced with an adult coat.

1.1.3 Distribution and Abundance

1.1.3.1 North America

Pronghorn are a unique species of the prairies and deserts of the Great Plains of North America (Frick 1937). Prior to European settlement, the North American pronghorn population was thought to be as large or larger than the vast herds of plains bison (Killaby et al. 1992, Mitchell 1980) it coexisted with (Schwartz and Nagy 1976). In pristine times the Great Plains produced millions of pronghorn, but intensive farming has reduced current pronghorn distribution to peripheral ranges, which historically supported low-density populations (Schwartz and Nagy 1976). The prairies of western Canada form the northern limit of pronghorn distribution (Dirschl 1963).

1.1.3.2 Saskatchewan

Pronghorn distribution corresponds closely with the mixed grassland ecoregion of Saskatchewan. In its natural state, this ecoregion is characterized by mid-grasses (wheat grasses and spear grasses) and short grasses (e.g., blue gramma grass) growing in mixed stands (Acton et al. 1998). Snowberry and sagebrush shrub lands frequently occur in depressions and on sandy soils of the ecoregion. The mixed grassland ecoregion is a broad plain interrupted by deep scenic valleys (e.g., Frenchman River) and hilly uplands (e.g., Cypress Hills, Wood Mountain Plateau, Old-Man-on-His-Back Plateau) (Acton et al. 1998). About 50% of this ecoregion has been cultivated. Greatest pronghorn concentrations typically occur on the broad expanses of natural habitat, rangeland, and pastureland typifying the ecoregion that have not been fragmented or lost to cultivation (Figure 1).

The extent and quality of winter range is related to the distribution pattern of preferred fall and winter forage (e.g., sagebrush and creeping juniper), which represent limiting factors governing the size of the pronghorn population in Saskatchewan (Dirschl 1963). Other limiting factors affecting distribution are anthropomorphic (e.g., impassable fences, loss of habitat to cultivation or energy extraction) and natural barriers (e.g., rivers, highways, habitat, drought, snow cover) to movement and migration.

Pronghorn in Saskatchewan are at the northern limit of their range and are therefore subjected to climatic extremes which cause significant population fluctuations (Dirschl 1963, Glasgow 1990, Killaby et al. 1992). The vast herds of the Great Plains were reduced to remnant herds by the end of the 19th century through a combination of environmental (i.e., series of summer droughts and harsh winters) and anthropogenic (e.g., market hunting, habitat conversion to agricultural cropland and for cattle grazing, impassable fences) factors. Hornaday (1913) estimated the 1908 Saskatchewan population to be 2,000, and 5 years later revised it downward to 1,500. Killaby et al. (1992) reference an anonymous source which estimated the 1921 pronghorn population in Saskatchewan to be 200. Conservation efforts, including hunting season closures in Saskatchewan, Alberta and Montana, allowed populations to recover. By 1936, they had reached a level in Saskatchewan where a limited hunting season could occur (Killaby et al. 1992).

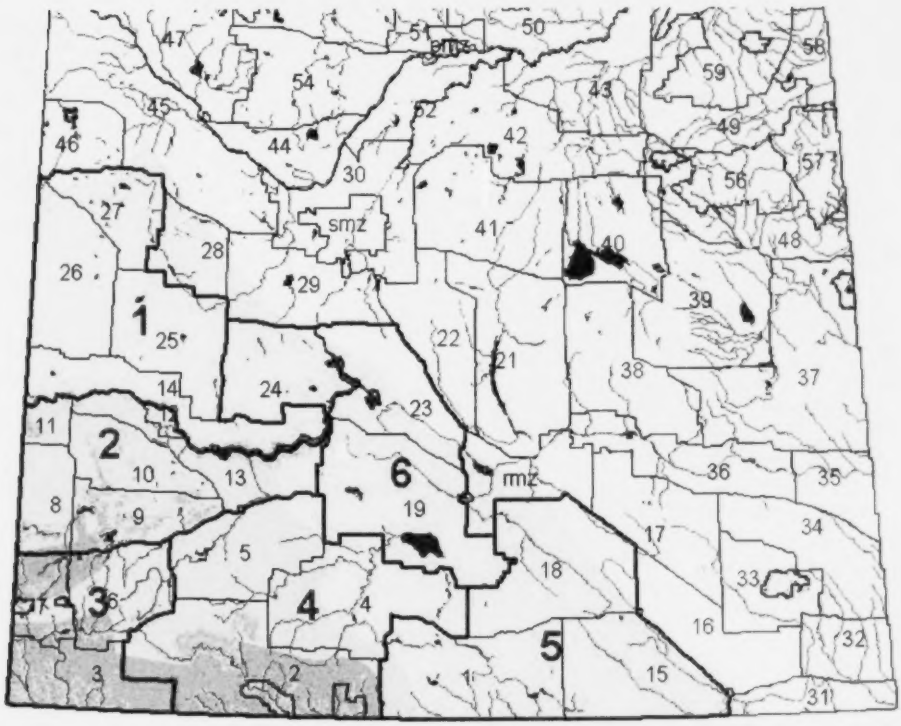

Figure 1. Pronghorn range in Saskatchewan.

Saskatchewan began systematic surveys of pronghorn in 1949 (Benson 1956), and from that time through to the 1970s the population fluctuated around 15,000 animals (Figure 2). The 1980s allowed improved winter survival and population growth into the mid 1990s. Hunting seasons were adjusted to take advantage of the growing populations. The heavy hunting pressure was followed by a series of years with poor fawn recruitment, causing the population to crash in the late 1990s (Figure 2). This resulted in a hunting season closure from 1997 through 2001. Since that time, range conditions have generally improved, resulting in improved recruitment and population growth as well as allowing the hunting season to reopen.

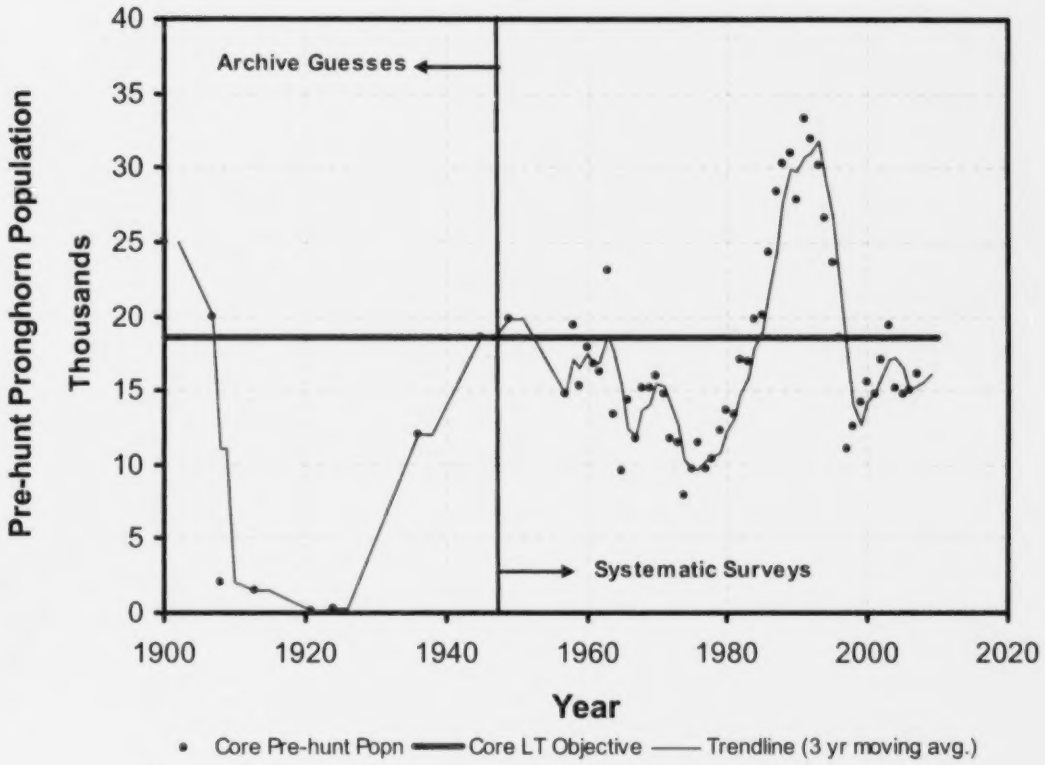

Figure 2. Pronghorn autumn (pre-hunt) population trend and long-term objective for core range (WMZs 2-13).

1.2 Habitat Selection

Assessing habitat use in relation to availability determines habitat selection (Bradshaw et al. 1995). Habitat selection occurs at several levels, is variable, and reflects the strategies used by an animal to meet habitat requirements through selection of different environmental features at each level of spatial and temporal scale to optimize biological fitness (Bradshaw et al. 1995, Holling 1992, Johnson 1980, Orians and Wittenberger 1991). Habitat selection patterns may also vary among populations studied at the same scale (Anderson 1999). At a particular scale, differential habitat selection among populations may be due to a particular population's response to influences such as forage availability, predation, disturbance, etc. in their home range (Anderson 1999, Orians and Wittenberger 1991). Even in a completely suitable region, not all habitat is occupied, because some time elapses before a territory vacated by the death of an individual is re-colonized by a dispersing juvenile (Lande 1988, Lande 2002).

Pronghorn are able to survive in a variety of climates over a large latitudinal distribution from Mexican desert to Canadian prairie. In Canada, pronghorn prefer gently rolling topography on native prairie during summer, and steeper slopes and ridges in winter, which function as snow-free feeding areas (Dirschl 1960). Pronghorn generally use sites with < 10% slope and avoid terrain with slopes > 20% (Lee et al. (1998). Differentiation of range use among seasons and within a season is based on snow accumulation, distance to foraging areas and water sources (Lee et al. 1998). Pronghorn rely on keen eyesight, vigilant watch, and rapid flight to avoid predation. Therefore, the open cover provided by grassland habitats, and grassland habitats interspersed with low shrubs are preferred. Pronghorn prefer a mixture of forb, grass and shrub vegetation in a sub-climax condition. Sub-climax conditions were historically created by wildfire and grazing patterns of pronghorn in association with bison, elk and/or deer (Kindschy et al. 1978). A symbiotic relationship between pronghorn and bison may have historically existed whereby heavy grazing of grasses by bison stimulated the forb and browse growth used by pronghorn (Kindschy et al. 1978).

Summer habitat preference is for vegetative communities in a sub-climax condition, characterized by a variety of mixed forage classes of grasses, forbs and browse with 60-80% vegetative cover (Lee et al. 1998). Pronghorn prefer vegetative communities composed of 40-60% grasses, 10-30% forbs and 5-20% shrubs, with mean height of 38 cm (Autenrieth 1983, Glasgow 1990). Areas with taller vegetation (>76 cm and > 30% canopy cover) are generally avoided (Autenrieth 1983). When summer range conditions become dry, pronghorn tend to concentrate their activity along stream drainages, wetlands, lakes and stock dams where there is a greater abundance of green vegetation (Dirschl 1960).

Winter range is critical to survival of pronghorn in Saskatchewan and is characterized by sagebrush dominated landscapes and exposure to Chinook influences or wind scouring to reduce snow depths. Sagebrush dominated cover is preferred in winter provided snow depth is minimal. The distribution pattern of sage brush and creeping juniper indicates that suitable pronghorn range in Saskatchewan is much less in winter than in summer (Dirschl 1963). The extent and quality of winter range is the limiting factor dictating pronghorn distribution and abundance (Dirschl 1963), which is further influenced by anthropogenic barriers (e.g., fences, roads) and habitat alteration/loss (e.g., land conversion for livestock, crops, resource exploration, and development).

Females seek areas with greater than average shrub cover and height for fawning. They commonly select shallow depressions in gently rolling prairie, with a cover of sagebrush and snowberry, for birthing areas (Dirschl 1960) in spring. Close proximity (<1.5 km) to water also influenced preference for a fawning area (Dirschl (1960). Breeding territories occupied during the autumn rut have a higher density and diversity of preferred plant species compared to areas not selected (Copeland 1980).

1.2.1 Weather

Pronghorn range in Canada is cool, semi-arid prairie, subject to high rates of evaporation, prolonged periods of drought, and extremes in temperature between seasons. Drought and severe winter weather can result in shifts in pronghorn distribution on their range (Bruns 1977), and/or predispose them to increased mortality through exposure, starvation or predation (Compton 1970, Martinka 1967, McKenzie 1970, West 1970). Newborn pronghorn kids are particularly vulnerable to severe late-spring weather-related exposure and death. Pronghorn populations will succumb to long cold winters, and will move great distances to avoid deep snow in search of suitable forage (Glasgow 1990). Drought years with poor vegetative growth reduce population growth through lowered fawn production (Mitchell 1985). Pronghorn can scratch through light snow for food (Bruns 1977), but deep snow (>25-30 cm) forces them to other portions of their range where browse availability is better, or to uplands where wind has swept away expanses of snow (Autenrieth 1978, Whitaker 1996).

Temperature is generally not a major population-limiting factor. Pronghorn are adapted to hot dessert ecosystems and alpine plateaus (Autenrieth 1983). However, freezing temperatures in combination with precipitation during fawning can cause significant neonate mortality.

1.2.2 Water

Water availability is important to pronghorns and optimally water sources should be no more than 5-6 km apart (Glasgow 1990). The climate of Saskatchewan pronghorn range is primarily semiarid; consequently, areas where water is readily available are more attractive to pronghorn (Dirschl 1960).

There are some portions of pronghorn range where pronghorn can acquire sufficient water through their diet that they don't require a water source during spring and summer (Beale and Smith 1970). When forage moisture content exceeds 75%, pronghorn do not need to drink surface water (Kitchen and O'Gara 1982). However, water likely affects pronghorn distribution through its influence on the abundance and distribution of succulent vegetation (Dirschl 1960). Pronghorn prefer water in a pH range of 6.5 to 8.5, and avoid alkaline water above pH 9.25 (Kindschy et al 1978, Prenzlow et al. 1968).

1.2.3 Forage/Nutrition

Pronghorn are ruminant grazers and browsers, which consume a wide variety of plant species depending on abundance, palatability, succulence, and availability across their range (Beale and Smith 1970, Schwartz and Nagy 1976). They feed selectively to maximize protein intake and minimize fiber content (Beale and Smith 1970). This is necessary because they have a smaller ratio of rumen volume to body weight, compared to domestic livestock, and a small rumen cannot efficiently process low quality/high fiber foods (Hanley 1982, O'Gara 2004a, Schwartz et al. 1977). The leafy portions of forbs and shrubs are rapid to digest and are higher in protein, with lower fiber content in comparison to grasses (Short et al. 1974).

In winter, pronghorn browse on many different plants, but favor sagebrush (Bayless 1969, Dirschl 1962, Whitaker 1996). The presence and abundance of shrubs, particularly sagebrush *(Artemesia cana)*, during winter is an important factor affecting the value of a rangeland area as pronghorn winter habitat (Dirschl 1960). Sagebrush retains the highest nutritive value during winter months of any of the various shrub species present in the prairies of southwestern Saskatchewan (Dirschl 1960). Sagebrush can constitute as much as 90% of the winter diet of pronghorns in the northern portions of their range (Autenrieth 1983, Bayless 1969, Beale and Smith 1970).

In summer, grasses and forbs, particularly pasture sage *(Artemesia frigida)*, compose a larger proportion of their diet (Dirschl 1960). Studies indicate pronghorn select a diet higher in quality (i.e., higher protein, lower fiber content) than sheep, cattle or bison (Schwartz et al. 1977, Schwartz and Nagy 1976). Beale and Smith (1970) found that forbs dominated diets in wet summers and browse dominated diets in dry summers. Forbs are of more critical importance for pronghorn survival and fawn production on more southerly ranges (Brown et al. 2003). Except for alfalfa, field peas, lentils, and wheat, pronghorn do not usually consume agricultural crops (Dirschl 1963, Kindschy et al. 1978).

1.3 Population and Community Ecology

1.3.1 Annual Movements

Pronghorn of the Canadian Great Plains are relatively sedentary on their summer range, have strong fidelity to their natal range, and will make large-scale movements to winter ranges only when environmental conditions are extreme (Hnatiuk 1976, Mitchell 1980, Killaby et al. 1992). Seasonal movements are dictated by habitat conditions, weather, and barriers (Lee et al. 1998, O'Gara 2004a). However, Sawyer et al. (2005) found that migratory pronghorn populations rely on seasonal ranges to meet their annual nutritional and energetic requirements. Further, they reported seasonal ranges often occurred great distances apart and across a mix of vegetation types and landownership, therefore it was important to maintain migration corridors to and from seasonal ranges. This would be difficult to do where detailed information on seasonal movements is limited.

In Saskatchewan, movements between summer and winter ranges of 200-250 km are common (Hnatiuk 1972, O'Gara 2004b). In a recent study, Gates et al. (2006) reported movements on Canadian range in the order of 445 km (from northern Montana through Alberta into Saskatchewan), which is the largest unidirectional seasonal movement recorded for a land mammal in Canada south of the tundra. Therefore, at least a portion of Saskatchewan's pronghorn population is known to make migratory movements. Berger et al. (2006) reported a migratory movement of 562 km in Wyoming.

Migration is an adaptive behavioral strategy that allows animals to cope with the spatio-temporal variability of weather, forage, and other resources across large spatial scales in temperate regions to avoid food shortages and to access food resources prior to breeding (Fryxell and Sinclair 1988, Fryxell et al. 1988, Sawyer et al. 2005, Sheldon et al. 2006). At a smaller scale, pronghorn herds can be quite migratory, moving among Wildlife Management Zones, or even in and out of the province depending on the extent of a short or longer-term environmental conditions (e.g. sever winter storm, severe winter conditions, protracted drought) (Bruns 1977, Martinka 1967). Roads and fences play an important role in determining the usage of winter range (Bruns 1977). Severe and prolonged winter conditions on the northern ranges generally cause large-scale movements to other portions of pronghorn range that provide food and protection from wind and deep snow (Mitchell 1983).

1.3.2 Home Range

The science literature reports substantial variation in home range size, depending on jurisdiction, season, sex, and degree of migratory movements (O'Gara 2004 b). Wiltse (1978) described the minimal area occupied by pronghorn in Saskatchewan to be 177 km^2. However, average home range sizes n other jurisdictions have been reported as significantly smaller; in the order of 26 – 40 km^2 (see O'Gara 2004b).

1.3.3 Dispersal

Dispersal has not been widely studied in pronghorn. Emigration is synonymous with dispersal and is a means by which gene flow occurs among populations. Limited gene flow (as low as one individual per generation) is suggested as sufficient to maintain metapopulation genetic heterogeneity (Lacy 1987, Lacy 1997). Seasonal dispersal over long distances is an important process facilitating genetic exchange within a population and among populations. This is necessary for population maintenance over the long term. Dispersal may be stimulated by the interaction of habitat quality (patchiness) and pronghorn density, where dispersal movements and home range size increase as habitat patch size decreases (Jacques and Jenks 2006).

1.3.4 Reproduction/Life History

Pronghorn have a polygamous mating system (Wright and Dow 1962). Older dominant males begin establishing territories in early April, by scent-marking with urine, feces, and subauricular gland secretions, and defend them through the end of rut (Glasgow 1990, Nowak 1999, Whitaker 1996). Sub-dominant males will group in the unclaimed areas. During this period, dominant bucks maintain harems of 2–15 does on their territories. Territories are defended by stare-downs, vocalizations, aggressive approaches, chasing, and occasional fights (Nowak 1999). Undisturbed dominant bucks which acquire a territory, will assure themselves a disproportionately larger share of the breeding (Copeland 1980, Kitchen 1974). In Saskatchewan, the rut occurs over a 3 week period, peaking near the end of September. Southern pronghorns breed from July through October (Buechner 1950).

Males are capable of breeding at 16 months of age, but generally do not do so until they are about 3 years of age (Nowak 1999) due to social dominance hierarchy of the herd and competition among bucks. Most females are 16 months old at first breeding, but occasionally breeding may occur at 4-6 months (Wilson and Ruff 1999, Wright and Dow 1962). Three to 7 ova are fertilized and begin embryonic development, but intrauterine mortality usually reduces the number of embryos to 2 within 6 weeks (Wilson and Ruff 1999). Pronghorns are the only artiodactyls known to conceive 2-3 times as many embryos as are born (O'Gara 1969). The gestation period spans approximately 252 days (Nowak 1999, Wilson and Ruff 1999). Fawns are born in late May through early June (Whitaker 1996). In Saskatchewan peak fawning occurs around May 25 (Dirschl 1960).

Does usually produce twin fawns, weighing 2-4 kg (Glasgow 1990, Nowak 1999, Wilson and Ruff 1999). First pregnancies generally produce a single fawn, but twins are the rule for experienced breeders, and triplets are rare (Wilson and Ruff 1999, Whitaker 1996). The neonate fawns are usually able to walk within an hour of birth and can run faster than a human within days, but the greater portion of the first couple of weeks of life is spent hidden (Wilson and Ruff 1999).

Fawns spend up to 90% of their first 3 weeks bedded some distance from their mothers, which reduces detection by predators (Glasgow 1990). By 3 weeks, fawns begin feeding on vegetation, and are capable at 7 weeks of age of surviving as orphans (Bromley and O'Gara 1967). At about 3-4 weeks, the dams and their fawns group together into nursery herds (Glasgow 1990). By September, fawns are generally weaned from their mothers.

1.3.5 Mortality

Pronghorn are not generally considered to be long-lived animals (O'Gara 2004a). Longevity is usually 7 - 10 years (Whitaker 1996), with a maximum-recorded longevity of 14 years for males (Jones 1993) and 18 years for females (O'Gara 2004a).

Fawn mortality is spatially and temporally variable and is highest from birth to 3 months of age (Mitchell 1980, Pyrah 1987, Killaby et al. 1992). A fawn mortality study by Gregg et al. (2000) found that most mortality occurred with fawns that were < 21 days old, with the majority of deaths attributed to coyote predation. They also reported that fawn mortality was greater for fawns born during non-peak parturition periods, which suggests that birth synchrony may be an important factor in fawn survivability.

1.3.5.1 Natural Predators

Major predators influencing pronghorn population dynamics are humans and coyotes *(Canus latrans)*. There is a strong correlation between coyote suppression and pronghorn kid survival (Smith et al. 1986). Coyotes can be responsible for as much as 45% of neonate fawn mortality during the first 60 days following parturition in Alberta (Glasgow 1990). Bobcats *(Lynx rufus)* and golden eagles *(Aquila chrysaetos)* also account for a portion of neonate fawn mortality in some portions of pronghorn range (Beale and Smith 1973). Populations occupying marginal habitat (e.g. dense and/or tall shrub predominate) are likely to experience high fawn mortality from predation (McNay 1980).

1.3.5.2 Diseases and Parasites

Some of the most common pronghorn pathogens are listed in Table 1. Further information on these diseases can be found in Lance and Pojar (1984), SAF (1990), and Wobeser (1990). Diseases and parasites are a relatively minor source of pronghorn mortality.

Table 1. Common diseases and pathogens known to affect pronghorn.

Disease/Pathogen	Common Name	Symptoms	Diagnosed Cases in Saskatchewan	
VIRAL				
Pox Virus	Contagious Ecthyma	Generally non-fatal, sore mouth, dermatitis	No	
Virus	Bluetongue (Epizootic haemorrhagic disease)	Fatal, internal hemorrhage central nervous system depression	No	
Virus	Malignant Catarrhal Fever	Lesions	No	
RICKETTSIAL				
Anaplasma marginale (Rickettsial)	Anaplasmosis	Anemia	No	
Chlamydia psittaci	Chlamydia	Pneumonitis		Yes
PROTOZOAN (Bacteria)				
Campylobacter fetus	Vibriosis	Infertility and abortion	No	
Corynebacterium Pseudotuberculosis	Caceaous Lymphadenitis (lumpy jaw)	Fatal lymph node infection	No	
Fusobacterium necrophorum	Necrobacillosis (foot rot)	Foot rot, liver abscesses		Yes
Moraxella bovis	Conjunctivitis (pink eye)	Pink eye, cornea perforation	No	
Leptospira spp.	Leptospirosis	Fevers, impacts reproductive system	No	
NEMATODES (Roundworms)				
Parelaphostrongylus tenuis	Meningeal brain worm	Fatal neurological disease	No	
Other Parasites (see Lance and Pojar 1984)				

1.3.5.3 Abiotic Factors

Pronghorn, particularly fawns, are very susceptible to weather-related mortality (Killaby et al. 1992). Severe winters can result in significant mortality through exposure and malnutrition (Glasgow 1990), and can reduce kid production in the following spring (Martinka 1966, Wishart 1970). Fawns are the most vulnerable portion of a population to winter mortality and usually succumb earlier than adults (Martinka 1967). Mature males are the next most vulnerable class, whereas mature females are substantially more resistant to winter mortality.

1.3.5.4 Accidental Death

Vehicle collisions and railways can potentially result in mortality during periods of deep snow if snow-free raised roads and railways are used as traveling and feeding corridors. Pronghorns sometimes also can get caught up in fences. In some circumstances fences can act as a physical barrier to movement for populations trying to avoid severe winter conditions.

1.3.5.5 Hunting

Sustainable harvests are a dynamic metric related to ungulate density (Caughley 1976). At extremely low densities, sustainable harvest levels are nil or very limited because of low stocks and limited ability for an ungulate population to compensate.

Hunting during the rut prevents the dominant, most vigorous bucks in a population from doing the bulk of the breeding because they are harvested, or the dominance hierarchy and social order created by territorial regime is disrupted, which allows indiscriminant breeding of females by non-territorial subordinate males (Copeland 1980, Deblinger and Alldredge 1989, Ficher and Autenrieth 1978). This has a negative effect on population fitness by reducing the genetic contribution by dominant males to future generations, and by allowing genetic contribution from subordinate males who would otherwise have be excluded in an unaltered social dominance hierarchy established by the rut.

1.3.6 Competition

There is evidence to suggest that historically pronghorn did not compete with the plains bison they historically coexisted with, nor is there evidence of competition with domestic cattle because of dietary differences (Schwartz and Nagy 1976). Studies of dietary overlaps comparing pronghorn to sheep, cattle and horses, report that pronghorn and sheep have the most similarity in food habits on sagebrush grassland (Autenrieth 1983, Buechner 1950, Clary and Beale 1983, Olsen and Hansen 1977).

1.3.7 Population Structure

Mid-summer productivity ratios of 0.60 - 0.79 fawns/doe is considered to yield an average level of recruitment on grassland habitat in Montana (Lee et al. 1998). In Saskatchewan, the long-term (1960-2007) mean productivity ratio is 0.55 fawns/doe, ranging from 0.13 - 1.07 fawns/doe.

1.3.8 Ecological Role/Significance

Large herbivores generally require some form of management within their habitats. They are major drivers for forming the shape and function of terrestrial ecosystems through their effects on the environment (e.g., grazing) and nutrient cycling (Danell et al. 2006).

Pronghorn are a ruminant animal endemic to the North American prairie ecosystem, and historically were closely associated with bison (Yoakum 1972). Pronghorn are an obligate grassland species of sage-steppe habitat and are widely distributed across the prairie ecosystem. They are primarily a forb-eating species with strong requirements for open cover, areas with low, sparse shrubs, and areas with taller, denser shrubs for fawning (Holechek 1981).

Pronghorn make landscape choices based on learned migration behavior and are known to undertake long distance movements. Wide ranging species such as pronghorn are vulnerable to landscape fragmentation caused by roads, fences and competing human land uses, which can restrict animal movement and alter habitat quality and use (Gavin 2004). Habitat loss and fragmentation impact populations at the landscape scale. Changes in land use can be measured by population response through habitat selection, movement pattern, and demographic response (such as change in population density, or distribution).

Pronghorn are valued as a big game species. They have charismatic and esthetic value to the prairie landscape. There is a higher social tolerance for pronghorn compared to elk or deer.

1.3.9 Threats to Population Status

Threats to population status include:

- Loss of movement corridors (Berger et al. 2006)
- Barrier effects (e.g., roads, fences) resulting in lowered daily movement rates and effects on population dynamics and gene flow.
- Increased mortality risk due to scaring caused by barbed wire fences.

2.0 Status and Management

2.1 Pronghorn Management Units (PMUs)

Assessing the distribution of concentrations of pronghorn in relation to landscape areas defined by Acton et al. (1998), critical pronghorn habitat, and Wildlife Management Zones, allowed delineation of several pronghorn meta-population ranges based on an ecological framework (Figure 1). A metapopulation is a set of populations that exist in distinct habitat patches interspersed into a matrix of non-habitat and linked through dispersal (Kohlmann 2004). The meta-population ranges can be used as Pronghorn Management Units (PMU) to provide a framework, which functions as a basis to assess the status of each meta-population, using management-by-objective (MBO) and adaptive management (AM) approaches. Management is most effective in meeting goals and objectives when they are established for population units and data are collected so that inference to population units is possible (Strickland 2001).

2.2 Population Status

2.2.1 Pronghorn Survey Design

Killaby et al. (1992) describes survey methods used to inventory pronghorn in Saskatchewan prior to 1990. In 1990, Saskatchewan began using a line transect method for collecting population density data (Guenzel 1997, Killaby et al. 1992), which in recent years has been analyzed using *DISTANCE 3.5* (per Thomas et al. 1998, also see Buckland et al. 1993). Survey effort should focus solely on core population ranges because of cost effectiveness and because fringe populations are only maintained if core populations are healthy.

2.2.2 Population Dynamics

To effectively manage an ungulate species, its population dynamics must be thoroughly understood. Changes in habitat structure, connectivity, quality, and/or quantity indirectly influence survival and reproduction of an animal. Significant increased mortality can occur if a proper balance between winter range and population size is not maintained (Compton 1970). In population ecology, direct and indirect factors that limit a population (eg. habitat quality, habitat quantity, habitat fragmentation, mortality variables, reproductive potential, etc.) are inter-related. In winter, group size is thought to depend on the extent and quality of the winter range (Dirschl 1963), and snow cover (Bayless 1969).

2.2.3 Population Demographics

Aerial surveys are the best method available for unbiased assessment of pronghorn population demographics such as density, adult sex structure, and fawn production. These are essential metrics required for trend analyses to answer the question of whether the population of interest is below or above the management objective, and determine the appropriate management prescription. Requirements for detecting trends in populations are the existence of long term data sets (i.e., > 15 years of data) collected in a consistent and systematically unbiased manner (Kohlmann 2004). Road surveys to determine herd structure are also being assessed as a possible alternative to the more expensive aerial survey approach.

2.3 Habitat

2.3.1 Habitat Fragmentation

Anthropogenic factors can contribute or exacerbate the effects of severe weather (e.g., drought, snow, etc.). Anthropogenic factors impacting pronghorn habitat are categorized into two groups: functional habitat loss and direct habitat loss.

Functional habitat loss occurs when pronghorn are disturbed or displaced from an otherwise suitable area. Studies of captive pronghorn indicate sensitivity to disturbance from human presence and vehicular noise. Pronghorn evolved on open plains where speed was necessary and the ability to jump was not (O'Gara 2004a). Pronghorn generally do no jump fences, but can pass under or between strands of barbed wire. Livestock fences, particularly those designed for domestic sheep can severely restrict pronghorn movement. Fences and roads limit day-to-day movements (Bruns 1977). Woven (page) wire and highway right-of-way fences form barricades that curtail herd movement, which, during severe winters or drought can contribute to extensive mortality (Benson 1956, Hailey et al. 1966, Prenzlow 1965, Wilson and Ruff 1999). Cattle grazing in pronghorn fawning areas during the fawning season can displace does to less suitable birthing areas resulting in increased fawn mortality (Yoakum and O'Gara 1990). Vehicle traffic may be perceived by pronghorn to be a predation risk, causing avoidance behavior which, in turn limits habitat use affects foraging behavior and cause increased energy expenditure at critical periods such as in winter or during the reproductive period (Gavin 2004). The strength of the behavioral response to the human disturbance may alter habitat use proximate to the disturbance through avoidance, displacement, or abandonment of the habitat.

Direct habitat loss occurs as a result of drastic physical alteration of habitat. This occurs through conversion and development of sagebrush communities into cultivated cropland and livestock pasture. Livestock grazing and excessive cultivation of arid landscapes barrier effects to essential movements caused by transportation corridors (e.g., highways, railroads) and developed areas (e.g., intensive livestock management, impassible fences, energy development, irrigation canals, rural and urban settlement). Fences, road networks, and/or increased disturbance associated with energy and housing developments can influence the effectiveness of pronghorn migration routes (Sawyer et al. 2005) and habitat use (Gavin 2004). When these features along with natural landscape features (e.g., topography, vegetation) result in restricted animal movements to narrow or limited regions, a migratory bottleneck is created. Bottlenecks are a management concern because of the potential to disrupt or threaten established migratory routes, which in turn affects seasonal range use and access, and ultimately affects population status, biodiversity, and ecosystem health.

2.3.2 Habitat Connectivity

Habitat by itself does not determine whether a species will persist or recover. Population persistence depends on the amount and spatial distribution of habitats across a landscape, what dynamics are occurring within the habitat that may affect the population or its occupied habitat, and the scale at which the organisms interact with landscape pattern (Keitt et al. 1997). Migratory pronghorn populations rely on seasonal ranges to meet their annual nutritional and energetic requirements, but these seasonal ranges often occur with significant spatial separation across a mix of vegetation types and landownership (Sawyer et al. 2005). Maintenance of migration corridors between seasonal ranges requires detailed information on seasonal movement patterns to ensure functional range and landscape connectivity.

Habitat connectivity refers to the configuration and relative juxtaposition (structural connectivity) of habitat patches within a landscape matrix, and whether there are any barriers affecting the dispersal ability (functional connectivity) of a species within the landscape matrix. Wildfire and human activities fragment habitat. This represents significant habitat alteration, which for some species represents habitat loss and fragmentation, and subsequent isolation of populations in the remnant habitat patches.

The connectivity between the remnant habitat patches is essential to natural movement, dispersal ability, gene flow, and ultimately the future viability of populations, particularly if the population is small and/or exists at low density. Maintenance of connectivity of remnant habitat patches is necessary in a fragmented landscape to ensure ecosystem function and long-term persistence of pronghorn populations. At the individual level, loss of habitat connectivity can significantly reduce the ability of an individual to exploit resources (e.g., nutrition, access to mates, predator avoidance) within its home range. At the population level, reduced habitat connectivity has significant implications to long-term population viability. Implications include a decreased ability to respond to short and long-term habitat changes, and reduced genetic variability due to increased isolation, and impaired dispersal.

2.4 Historic and Current Harvest Management

2.4.1 Subsistence Use

Cree Indians referred to pronghorn as "Ah-pi-chei-ah-tik" meaning small caribou (Benson 1956). Sioux Indians called pronghorn "small deer" or "pale deer" (Hutchins 1999).

2.4.2 Licensed Harvest

In nearly all jurisdictions that have pronghorn hunting seasons, hunting is via limited quota or limited entry licenses, so that hunter distribution and harvest level can be controlled (Lee et al. 1998).

Desired adult sex ratios depend on the management goal. Maximum trophy production requires a post-hunt buck/doe ratio of 0.50 or more (O'Gara and Yoakum 1992). Maximum recruitment into a population requires maintenance of a post-hunt buck/doe ratio of 1:4. A post-hunt buck/doe ratio of 1:5 is a biologically safe objective (Lee et al. 1998).

Killaby et al. (1992) provide a summary of harvest and season structure for several decades prior to 1990. Throughout the mid 1930's to 1990 pronghorn were harvested on an either-sex draw license. The draw allocation was significantly liberalized in 1991 and 1992 with the addition of non-trophy licenses. Pronghorn were taken off the draw system in 1993 and 1994 in place of over-the-counter regular licenses. Declining populations resulted in reinstitution of the draw for the next 2 years, followed by a season closure for 5 years. In 2002 the season was reopened as a bucks-only draw with very conservative quotas. By 2005 the population had recovered sufficiently to allow a change to draw either-sex harvest. Licensed harvest by PMU since Killaby et al. (1992) is summarized in Appendix 3.

3.0 Management Strategies

3.1 Management Approaches

3.1.1 Coarse Scale / Ecosystem-based Management

Ecosystem-based management is a landscape planning approach to natural resource management with the intention of maintaining biodiversity and ecosystem integrity while integrating economic and social objectives (Haufler et al. 2002). Any process which fragments the landscape, restricts pronghorn movement, and/or makes pronghorn more spatially and temporally predictable, can result in increased vulnerability to mortality. Sustainable pronghorn populations require maintenance of range occupancy at natural levels of abundance within a managed prairie ecosystem.

Ecosystem-based management at the **landscape level** relates to the mix of ecosystems occurring in the planning landscape used by pronghorn relative to the mix that occurred under historical disturbance regimes. At the **ecosystem (stand) level**, each ecosystem used by pronghorn can be assessed on the basis of composition, structure, function and process relative to historic range. At this level, human activities that impact habitat could be influenced by quantitatively incorporating wildlife habitat attributes within the management framework that habitat is altered by. The spatial scales and temporal periods over which habitat alteration occurs, should match the scales and periods of habitat use by wildlife species. At the **species level**, the viability and population parameters for pronghorn in the planning landscape can be related to the same measures in historic range, to assess and ameliorate industry impacts.

3.1.2 Fine Scale / Population Management

The key component of all wildlife population studies is to understand population dynamics by determining whether populations are increasing, decreasing, or stable over time. It is also important to understand the mechanism(s) influencing population status. The fine scale approach is required for any wildlife species or population that is not limited by habitat, but is limited by other factors such as hunting, or increased mortality as a consequence of direct or indirect human effects on the landscape.

To address this conservation focus, both a management-by-objective (MBO) approach and an adaptive management (AM) approach can be used. An MBO approach is accomplished through a planned management system (Arsenault 1998, Arsenault 2000, Arsenault 2003, Strickland 2001). This includes inventory of managed resources through area specific collection and assessment of population and habitat metrics, identification of management goals and objectives, management actions, and evaluation of the response of resources to management (Strickland 2001). MBO Is typically adaptive in that evaluation may lead to changes in any component within the planned management system (Strickland 2001). Management actions can be structured in an adaptive management frame (Walters and Holling 1990) to learn from, and improve future management/conservation actions within ecosystem-based management principles.

3.2 Policy Framework

Saskatchewan Environment's corporate mandate is to manage, enhance and protect Saskatchewan's natural and environmental resources (fish, wildlife, forests, lands, parks and protected areas, air, water, and soil) for conservation, recreation, social and economic purposes, and to ensure they are sustained for public benefit and for future generations.

The **Fish and Wildlife Policy Framework** defines the principles of ecosystem-based management, which currently defines the policies and direction within which programs are developed, delivered and integrated.

First Nations, Métis, industry, other agencies, and stakeholders have an interest, expertise, and resources to devote to pronghorn management and recovery planning. Industry has a specific responsibility (requirement of doing business on the landscape) to be actively involved in pronghorn conservation and research. Other agencies, stakeholders, First Nations and Métis have a responsibility of sharing local knowledge and active participation in pronghorn conservation.

3.3 Population Management

3.3.1 Goal

To ensure that viable populations of pronghorn are maintained in their present ecological occurrence at a density and structure that is ecologically sustainable.

3.3.2 Objective

To establish and/or maintain optimal pronghorn populations in each PMU (Table2).

Table 2. Pronghorn long-term pre-hunt population demographic objectives (±20%) for Saskatchewan.

Pronghorn Management Unit (PMU)	WMZs	Population Size (± 20%)				Density (Pronghorn/km²)		Adult Sex Ratio (M/F)	Productivity Ratio (y/F)
		Males	Females	Young	Total	Adults	Total Pop.		
Govenlock	3, 6, 7	1,428	3,070	1,502	6,000	0.39	0.52	0.47	0.50
Frenchman	2, 4, 5	1,768	3,508	1,724	7,000	0.21	0.28	0.50	0.49
Great Sandhills	8 - 13	1,308	2,672	1,520	5,500	0.25	0.34	0.49	0.57
Core Range Total		4,504	9,250	4,746	18,500	0.26	0.35	0.50	0.54
Big Muddy	1, 15, 18	287	618	295	1,200	0.04	0.05	0.47	0.48
Kindersley	14, 25-27	279	588	333	1,200	0.04	0.05	0.47	0.57
Diefenbaker	19, 23, 24	173	339	188	700	0.02	0.03	0.51	0.56
Fringe Range Total		739	1,545	816	3,100	0.03	0.05	0.48	0.53
PROV. RANGE TOTAL		5,243	10,795	5,562	21,600	0.26	0.35	0.50	0.54

In core populations, pre-harvest adult sex ratios should be > 0.25 M/F to ensure adequate recruitment and should be > 0.50 M/F to maximize trophies. An adequate post-harvest adult sex ratio should be ≥0.20 M/F.

3.3.3 Issues and Strategies

Issues	Strategies
1. Long-term conservation of pronghorn must occur within the principles of ecosystem management.	➢ Population management strategies must compliment the coexistence of other naturally occurring species. ➢ Populations should be managed at natural levels of abundance and structure. This requires systematic monitoring and assessment. ➢ Population management prescriptions should occur within an adaptive management framework. ➢ Ensure population connectivity within and among adjacent PMUs is possible by ensuring habitat connectivity and seasonal range use is not compromised.
2. Aerial surveys are the most effective method for assessing population status and demographics in response to management prescription. This requires considerable effort (i.e., survey frequency and size of survey area) and resources (e.g., budget, manpower, equipment). Monitoring is an essential requirement for assessing the effects of harvest on wildlife populations.	➢ A long-term systematic approach is necessary to assess and monitor population demographics, to quantify progress towards PMU specific objectives, and to establish a baseline from which to manage effectively. ➢ Adult density surveys should be conducted in late May/early June, before fawns become mobile. ➢ Population structure surveys should be conducted in late June/early July to assess fawn production and pre-hunt population size. ➢ Early fall surveys (Sep/Oct) are less desirable because early fawns can be mistaken for does, which would bias adult sex ratio and fawn production estimates. ➢ Adult density and population structure surveys should be conducted only in core pronghorn range in each PMU at least once every 3 years to assess population status relative to long-term objectives. Sampling fringe range PMUs should not occur because of the transient nature of these low-density populations. The greater the survey frequency of core PMUs, the more precise the estimate of rate of population growth (r). ➢ Sampling effort for density estimates should strive for a minimum survey precision of 90% C.I. ±20% ➢ Sampling effort for population structure estimates should strive for a minimum precision of 90% C.I. ±20%. In core range PMUs at or near their adult density objectives this represents a sample of 400-600 animals/PMU. ➢ Population monitoring should occur only in core range (WMZs 2-13), with priority on Govenlock (WMZs 3,6,7), Frenchman (WMZ 2 and 5, possibly 4 if logistics permit), and Great Sandhills (WMZs 8 and 9, possibly 10-13 if logistics permit) PMUs. Monitoring effort should not occur in fringe range because of logistical constraints of low density populations and survey costs/effectiveness. ➢ If the allocation strategy is adjusted, then the population density and structure should be measured annually or biannually (depending on degree of adjustment) to assess effectiveness of the change of management prescription, within an adaptive management framework.

3.4 Allocation

3.4.1 Goal

Allocate surplus pronghorn to balance economic and social benefits to Saskatchewan residents, while conserving pronghorn and minimizing conflicts (e.g., hunter density, pronghorn crop depredation) with landowners.

3.4.2 Objective

Conserve pronghorn populations by optimizing the sustainable harvest of pronghorn from each PMU in priority of allocation, once conservation needs are met.

Table 3. Recommended sustainable pronghorn harvest levels for PMUs at the long term population size and structure objective, using a linked sex and age harvest strategy.

Pronghorn Management Unit (PMU)	WMZs	Pre-hunt Long Term Population Objective				Sustainable Harvest Objective			
		Male	Female	Young	Total	Male	Female	Young	Total
Govenlock	3, 6, 7	1,428	3,070	1,502	6,000	214	128	31	373
Frenchman	2, 4, 5	1,718	3,408	1,675	7,000	265	179	36	480
G. Sandhills	8 - 13	1,308	2,672	1,387	5,500	196	155	25	376
Big Muddy	1, 15, 18	287	619	294	1,200	43	33	6	82
Kindersley	14, 25 - 27	279	588	333	1,200	42	33	8	83
Diefenbaker	19, 23, 24	172	340	188	700	26	26	4	56
Total		5,192	10,697	5,379	21,600	786	554	110	1,450

Note: The sustainable harvest objective is based on harvest of 15% of the pre-hunt buck population. The either-sex license quota should be adjusted to reflect the hunter success rate typically attained in the PMU. Additional non-trophy (i.e., female, young) licenses should be made available if the number of females and young begin to significantly exceed the long-term objectives of a PMU.

3.4.3 Issues and Strategies

Issues	Strategies
1. The full compliment of predators in habitats used by pronghorn is no longer present. Therefore, natural predation is insufficient to regulate populations.	➢ Use hunting seasons to assist with regulating populations within natural levels of abundance as established by population demographic objectives presented in this report.
2. An allocation strategy should ensure biologically sustainable harvests over the long term by linking harvest composition and magnitude with population demographic objectives.	➢ Firearm hunting seasons should occur after the rut (i.e., after Oct 10) to avoid disruption of rutting activities and social hierarchy and subsequent negative effects on population fitness. This will maximize population breeding potential and population fitness by allowing dominant males opportunity to make their genetic contribution to future generations. This should also equalize the probability of mortality among dominant and non-dominant males, and allow a window of time (2-4 weeks) to hunt prior to casting of horn sheaths.
3. To attain population density and structure objectives, it is essential that a variety of allocation strategies be available for use either independently, or in combination as appropriate.	➢ Use a Linked Sex and Age Harvest strategy - Either-sex quotas for PMUs at population objectives should not exceed harvest of 15% of bucks, with consideration for the objectives for does and fawns in relation to typical harvest structure using either-sex licenses (i.e., use the size of harvest of each sex and young-of-the-year in relation to the other to a maximum allowable harvest that serves as a safety margin against over-exploitation). ➢ If populations exceed 20% of the long-term objective, an antlerless (hornless) quota should be implemented as part of the allocation strategy to return the population back to the structure and size objectives. ➢ If the population size falls consistently below the long term objective (ie. >10% below objective) then limit the harvest strategy to bucks-only (not to exceed 15% of bucks) with a quota reduction to 50 licenses or less. ➢ If population drops below 20% of the long-term objective, no license quota should be issued until the population has recovered to the population size objective (±20%) and recommended structure.
4. Throughout most of their range, pronghorn shed their horn sheaths between late-Oct. and mid-Nov.	➢ Peak of the rut occurs from end of September through early October. Season timing for trophy hunting should occur after the rut to maximize reproductive potential (i.e., avoid depletion of doe energy reserves and avoid breeding by immature or inferior bucks) (Autenrieth et al. 2006). ➢ Either-sex and antlerless (hornless) seasons should run concurrently.

3.5 Habitat Management

3.5.1 Goal

To ensure pronghorn core range remains as structurally and functionally connected as possible under the anthropogenic pressures of land use activities occurring on core pronghorn range.

3.5.2 Objective

To conserve pronghorn range function and connectivity in core PMUs and with high quality habitat in jurisdictions adjacent to core Saskatchewan range.

3.5.3 Issues and Strategies

Issues	Strategies
1. The effect of habitat fragmentation on pronghorn population dynamics is poorly understood.	➢ Assess how representative landscape habitat fragments are of the ecosystem and the level of functionality (patch connectivity). This would provide an effective means of measuring an effective threshold for pronghorn habitat capacity. ➢ Conduct a cumulative effects assessment of anthropogenic barriers to movement (e.g., fence lines, major roads) and habitat alteration (i.e., disturbance features affecting functional habitat use such as oil and gas development, livestock grazing, habitat conversion to agriculture) in each core PMU as a means of assessing habitat connectivity.
2. Seasonal range use by pronghorn is poorly understood and migration corridors at risk are unknown.	➢ Undertake telemetry studies to determine seasonal range use and movement patterns for migratory pronghorn populations. This would provide an effective means of assessing seasonal range use, movement patterns, and seasonal migration corridors on the landscape that require management action or protection.
3. Pronghorn occupying less fragmented landscapes are more likely to migrate than those occupying highly fragmented landscapes.	➢ Undertake telemetry studies to understand long-distance movement patterns which are important for genetic dispersal, genetic connectivity and population maintenance over the long term.
4. The foundation for habitat management is a base inventory of quantity and quality of food water, physiographic features, etc.	➢ Conduct periodic monitoring studies (5 year intervals) to determine the state of range condition in each core PMU so that significant changes to range status (i.e., static, improving or declining) can be detected early enough to evoke conservation measures. ➢ If suitable habitat is not available, no amount of predator control would result in a flourishing population of pronghorn. Therefore, predator control as a management tool is not recommended in fringe PMUs. ➢ If maintenance of pronghorn is a priority for the specific area affected, then predator management may be required to improve fawn survival and recruitment in areas where local pronghorn movement is restricted and local populations are isolated,.

Issues	Strategies
5. Fences, high traffic roads, and commercial and urban development present complete or partial barriers to movement patterns, which can influence range use patterns and ultimately population status.	➢ In conjunction with telemetry studies, assess fence type and distribution by PMU. ➢ Encourage pronghorn friendly fence construction methods (e.g., smooth wire at appropriate height, avoid use of woven wire). Pronghorn tend to cross fences by passing under the bottom wire. Karhu (2004) recommended use of smooth bottom wire with minimum heights of 25 cm for sheep and sheep/cattle applications, 40 cm for cattle operations, and 65 cm above ground for woven wire as standards that would allow pronghorn movement. ➢ Where possible, mitigate the impacts of oil field placement and development relative to pronghorn population and range distribution. Oil and gas development can pose as a large scale threat to pronghorn habitat occupancy through habitat loss and population displacement, as these types of development often intrude into previously undisturbed roadless areas. Winter range lands, seasonal movement corridors and fawning areas require special management consideration to reduce impacts of oil and gas activities. These impacts tend to be compounding and cumulative, therefore actions to protect and preserve pronghorn habitat should be planned, coordinated and applied to areas impacted. ➢ On core pronghorn range, pronghorn should be given high priority when considering fencing. A greater effort should be made to harmonize rangeland use by livestock and pronghorn. ➢ Range use is influenced by the presence (and type) of fences along road right-of-ways. Sheldon (2006) reported the use of seasonal crossings of primary roads consistently occurred along unfenced sections. This suggests that limiting fences on pronghorn range and maintaining unfenced sections of highways as movement corridors would reduce habitat fragmentation through loss of connectivity and allow increased access of pronghorn to more parts of their historic range.

3.5.4 Habitat Related Research Questions

Has cumulative change on the landscape made pronghorn more habitat dependant?

Has ecosystem function diminished, putting pronghorn at greater risk?

What is the land base required by a population? Does that change with declining habitat connectivity?

What is the population response to various grazing systems?

What types of "green" crossings (habitat corridors) are effective?

3.6 Science and Education

3.6.1 Goal

To promote public and stakeholder involvement programs and partnerships for pronghorn management in Saskatchewan and with adjacent jurisdictions that will enhance knowledge of pronghorn ecology and improve management capabilities.

3.6.2 Objective

To continually improve knowledge of pronghorn (and other sympatric wildlife species) biology, ecology and sustainable management in ways consistent with an ecosystem management approach.

3.6.3 Issues and Strategies

Issues	Strategies
1. There is a present lack of funding and staff resources to conduct large scale studies independently.	➢ Efforts are underway to work cooperatively in a multi-jurisdictional approach (e.g., WAFWA) to address these very concerns. ➢ Encourage, conduct and/or direct scientific and educational activities which enhance knowledge and management of pronghorn and other wildlife species, including partnerships with stakeholder groups and other jurisdictions in cooperative research and/or management studies.
2. The public is largely unaware or poorly informed of the purpose of population management, resulting in an anti-hunting sentiment.	➢ Public outreach messages should stress: a. Habitat loss is a major factor for diminishing wildlife populations. b. Strict regulations backed by biologically based monitoring programs govern hunting in order to link allocation with biologically-based, sustainable harvest levels. c. Hunting contributes significantly to wildlife management and conservation. ➢ Inform public of adjustments to pronghorn management through departmental information sources and the media as necessary.

3.6.4 Research Questions

How connected are populations between PMUs and between jurisdictions across pronghorn range, with respect to genetic dispersal, habitat corridors/movement patterns and range use?

4.0 Appendix

Appendix 1. Estimated annual pre-hunt pronghorn adult population density.

	Pronghorn Management Unit Adult Population Densities (#/km²)					
	Core Range			Fringe Range		
Year	Govenlock WMZs 3,6,7	Frenchman WMZs 2,4,5	Great Sandhills WMZs 8-13	Kindersley WMZs 14, 25-27	Diefenbaker WMZ 19, 24	Big Muddy WMZ 1,15,18
2007	ns	ns	ns	ns	ns	ns
2006	ns	ns	ns	ns	ns	ns
2005	0.406	0.131	0.298	ns	ns	ns
2004	ns	ns	ns	ns	ns	ns
2003	ns	ns	ns	ns	ns	ns
2002	0.463	0.289	0.180	ns	ns	ns
2001	0.314	0.188	ns	ns	ns	ns
2000	ns	0.184	ns	ns	ns	ns
1999	ns	0.178	ns	ns	ns	ns
1998	ns	0.135	ns	ns	ns	ns
1997	0.317	0.152	ns	ns	ns	ns
1996	0.334	0.306	ns	ns	ns	ns
1995	0.608	0.384	ns	ns	ns	ns
1994	0.667	0.402	ns	ns	ns	ns
1993	0.727	0.468	ns	ns	ns	ns
1992	0.787	0.527	ns	ns	ns	ns
1991	0.746	0.477	ns	ns	ns	ns
1990	0.521	0.370	ns	ns	ns	ns
1989	0.546	0.428	ns	ns	ns	ns
1988	0.438	0.409	ns	ns	ns	ns
1987	0.390	0.310	ns	ns	ns	ns
1986	0.342	0.273	ns	ns	ns	ns
1985	0.349	0.260	ns	ns	ns	ns
1984	0.297	0.239	ns	ns	ns	ns
1983	0.230	0.182	ns	ns	ns	ns
1982	0.285	0.209	ns	ns	ns	ns
1981	ns	ns	ns	ns	ns	ns
1980	ns	ns	ns	ns	ns	ns
1979	0.164	ns	ns	ns	ns	ns
1978	ns	ns	ns	ns	ns	ns
1977	ns	ns	ns	ns	ns	ns
1976	ns	ns	ns	ns	ns	ns
1975	ns	ns	ns	ns	ns	ns
1974	ns	ns	ns	ns	ns	ns
1973	ns	ns	ns	ns	ns	ns
1972	ns	ns	ns	ns	ns	ns
1971	ns	ns	ns	ns	ns	ns
1970	ns	ns	ns	ns	ns	ns
1969	ns	ns	ns	ns	ns	ns
1968	ns	ns	ns	ns	ns	ns
1967	ns	ns	ns	ns	ns	ns
1966	ns	ns	ns	ns	ns	ns
1965	ns	ns	ns	ns	ns	ns
1964	0.389	ns	ns	ns	ns	ns
Mean	0.364	0.207	0.232	0.044	0.027	0.034
Long-term Objective	0.387	0.213	0.247	0.039	0.026	0.039

ns = not surveyed

Appendix 2. Estimated annual fall (pre-hunt) pronghorn adult sex ratio (males/female) and productivity ratio (young/ adult female).

	Pronghorn Management Unit Population Structure											
	Core Range						Fringe Range					
	Govenlock WMZs 3,6,7		Frenchman WMZs 2,4,5		Great Sandhills WMZs 8-13		Kindersley WMZs 14, 25-27		Diefenbaker WMZ 19, 24		Big Muddy WMZ 1,15,18	
Year	M/F	Y/F	M/F	Y/F	M/F	Y/F	M/F	Y/F	M/F	Y/F	M/F	Y/F
2007	0.41	0.39	0.53	0.57	0.46	0.66	ns		ns		ns	
2006	0.60	0.30	0.45	0.38	ns		ns		ns		ns	
2005	0.53	0.32	0.39	0.50	0.39	0.52	ns		ns		ns	
2004	0.60	0.33	0.51	0.31	0.43	0.41	ns		ns		ns	
2003	0.47	0.59	ns		0.59	0.62	ns		ns		ns	
2002	0.47	0.13	0.48	0.10	0.33	0.18	ns		ns		ns	
2001	0.52	0.20	0.42	0.35	ns		ns		ns		ns	
2000	0.41	0.40	0.45	0.29	ns		ns		ns		ns	
1999	0.27	0.34	0.38	0.23	ns		ns		ns		ns	
1998	0.43	0.23	0.43	0.64	ns		ns		ns		ns	
1997	0.28	0.28	0.22	0.23	ns		ns		ns		ns	
1996	0.35	0.32	0.27	0.26	0.13	0.15	ns		ns		ns	
1995	0.41	0.18	0.26	0.15	0.11	0.24	ns		ns		ns	
1994	0.61	0.50	0.40	0.19	0.34	0.49	ns		ns		ns	
1993	0.26	0.35	0.32	0.19	0.48	0.64	ns		ns		ns	
1992	0.45	0.22	0.41	0.19	0.27	0.22	ns		ns		ns	
1991	0.46	0.33	0.67	0.44	0.45	0.42	ns		ns		ns	
1990	0.42	0.48	0.81	0.89	0.39	0.56	ns		ns		ns	
1989	0.53	0.63	0.61	0.61	0.55	0.77	ns		ns		ns	
1988	0.51	0.53	0.52	0.76	0.56	0.65	ns		ns		ns	
1987	0.37	0.95	0.58	1.06	1.07	0.62	ns		ns		ns	
1986	0.63	0.88	0.54	0.83	0.72	0.78	ns		ns		ns	
1985	0.56	0.61	0.67	0.58	0.41	0.72	ns		ns		ns	
1984	0.53	0.50	0.69	0.52	0.56	0.57	ns		ns		ns	
1983	0.40	0.66	0.63	0.86	0.53	0.78	ns		ns		ns	
1982	0.47	0.46	0.29	0.50	0.39	0.58	ns		ns		ns	
1981	0.44	0.68	0.59	0.63	0.28	0.78	ns		ns		ns	
1980	ns		ns		ns		ns		ns		ns	
1979	0.38	0.87	ns		ns		ns		ns		ns	
1978	ns		ns		ns		ns		ns		ns	
1977	ns		ns		ns		ns		ns		ns	
1976	ns		ns		ns		ns		ns		ns	
1975	ns		ns		ns		ns		ns		ns	
1974	0.44	0.53	0.49	0.48	0.37	0.79	ns		ns		ns	
1973	0.34	0.60	0.53	0.57	0.34	0.51	ns		ns		ns	
1972	0.45	0.66	ns		0.70	0.73	ns		ns		ns	
1971	ns		ns		ns		ns		ns		ns	
1970	ns		ns		ns		ns		ns		ns	
1969	ns		ns		ns		ns		ns		ns	
1968	ns		ns		ns		ns		ns		ns	
1967	ns		ns		ns		ns		ns		ns	
1966	ns		ns		ns		ns		ns		ns	
1965	ns		ns		ns		ns		ns		ns	
1964	0.75	0.68	ns		ns		ns		ns		ns	
Mean	0.47	0.50	0.50	0.49	0.49	0.57	0.47	0.57	0.51	0.56	0.47	0.48
Long-term Objective	0.47	0.50	0.50	0.49	0.49	0.52	0.51	0.71	0.51	0.71	0.47	0.48

Appendix 3. License type and harvest structure (Update from information presented in Killaby et al. 1992).

Pronghorn Management Unit (PMU)	WMZs	Hunt Year	License Type	Quota	Harvest Structure				
					Males	Females	Young	Unkn	Total
Govenlock	3,6,7	2006	Either-sex	350	249	32	9	0	290
		2005	Either-sex	300	261	13	0	0	274
		2004	Either-sex	301	215	21	3	0	239
		2003	Bucks only	200	178	0	0	3	181
		2002	Bucks only	150	145	0	0	0	145
		2001	No season	0	0	0	0	0	0
		2000	No season	0	0	0	0	0	0
		1999	No season	0	0	0	0	0	0
		1998	No season	0	0	0	0	0	0
		1997	No season	0	0	0	0	0	0
		1996	Either-sex	862	431	170	21	0	622
		1995	Regular season	—	358	112	20	0	490
		1994	Regular Season	—	341	143	25	0	509
		1993	Draw either-sex and Regular Non-trophy	na	269	384	55	0	708
		1992	Draw either-sex and Regular Non-trophy	na	524	741	102	3	1,370
		1991	Either-sex	na	801	827	161	3	1,792
		1990	Either-sex	na	922	363	41	0	1,326
		1989	Either-sex	na	687	392	42	12	1,133
		1988	Either-sex	na	623	189	21	0	833
		1987	Either-sex	na	519	203	41	0	763
Frenchman	2,4,5	2006	Either-sex	76	58	6	0	0	64
		2005	Either-sex	50	42	3	0	0	45
		2004	Either-sex	201	107	47	3	0	157
		2003	Bucks only	150	137	0	0	0	137
		2002	Bucks only	200	177	0	0	0	177
		2001	No season	0	0	0	0	0	0
		2000	No season	0	0	0	0	0	0
		1999	No season	0	0	0	0	0	0
		1998	No season	0	0	0	0	0	0
		1997	No season	0	0	0	0	0	0
		1996	Either-sex	701	311	187	18	0	516
		1995	Regular season	—	431	237	10	0	678
		1994	Regular season	—	550	384	55	0	989
		1993	Draw either-sex and Regular Non-trophy	na	495	805	138	0	1,438
		1992	Draw either-sex and Regular Non-trophy	na	877	1151	298	37	2,363
		1991	Either-sex	na	954	1274	180	3	2,411
		1990	Either-sex	na	945	345	38	0	1,328
		1989	Either-sex	na	843	182	20	4	1,049
		1988	Either-sex	na	776	223	38	0	1,037
		1987	Either-sex	na	531	234	28	0	793

Note: na = data not available

Appendix 3 (continued).

Pronghorn Management Unit (PMU)	WMZs	Hunt Year	License Type	Quota	Harvest Structure				
					Males	Females	Young	Unkn	Total
G. Sandhills	8 - 13	2006	Either-sex	326	237	37	9	0	283
		2005	Either-sex	375	290	33	2	0	325
		2004	Either-sex	251	202	16	0	3	221
		2003	Bucks only	152	135	0	0	3	138
		2002	No season	0	0	0	0	0	0
		2001	No season	0	0	0	0	0	0
		2000	No season	0	0	0	0	0	0
		1999	No season	0	0	0	0	0	0
		1998	No season	0	0	0	0	0	0
		1997	No season	0	0	0	0	0	0
		1996	Either-sex	655	214	87	13	0	314
		1995	Regular season	—	355	194	25	0	574
		1994	Regular season	—	498	371	60	0	929
		1993	Draw either-sex and Regular Non-trophy	na	806	969	140	4	1919
		1992	Draw either-sex and Regular Non-trophy	na	824	1690	284	15	2813
		1991	Either-sex	na	906	1168	211	0	2285
		1990	Either-sex	na	1295	628	95	0	2018
		1989	Either-sex	na	1073	430	40	11	1554
		1988	Either-sex	na	801	403	70	0	1274
		1987	Either-sex	na	665	279	40	0	984
Big Muddy	1, 15, 18	2006	No season	0	0	0	0	0	0
		2005	No season	0	0	0	0	0	0
		2004	No season	0	0	0	0	0	0
		2003	No season	0	0	0	0	0	0
		2002	No season	0	0	0	0	0	0
		2001	No season	0	0	0	0	0	0
		2000	No season	0	0	0	0	0	0
		1999	No season	0	0	0	0	0	0
		1998	No season	0	0	0	0	0	0
		1997	No season	0	0	0	0	0	0
		1996	Either-sex	201	51	62	10	0	123
		1995	Regular season	—	116	92	20	0	228
		1994	Regular season	—	183	134	30	0	347
		1993	Draw either-sex and Regular Non-trophy	na	380	330	38	0	748
		1992	Draw either-sex and Regular Non-trophy	na	308	398	79	3	788
		1991	Either-sex	na	216	181	42	0	439
		1990	Either-sex	na	234	56	9	0	299
		1989	Either-sex	na	51	37	9	0	97
		1988	Either-sex	na	88	16	0	0	104
		1987	Either-sex	na	43	5	0	0	48

Note: na = data not available

Appendix 3 (continued).

Pronghorn Management Unit (PMU)	WMZs	Hunt Year	License Type	Quota	Harvest Structure				
					Males	Females	Young	Unkn	Total
Kindersley	14,25,26	2006	Either-sex	75	70	5	0	0	75
		2005	Either-sex	75	57	14	0	0	71
		2004	No season	0	0	0	0	0	0
		2003	No season	0	0	0	0	0	0
		2002	No season	0	0	0	0	0	0
		2001	No season	0	0	0	0	0	0
		2000	No season	0	0	0	0	0	0
		1999	No season	0	0	0	0	0	0
		1998	No season	0	0	0	0	0	0
		1997	No season	0	0	0	0	0	0
		1996	Either-sex	127	60	36	0	0	96
		1995	Regular season	---	116	58	15	0	189
		1994	Regular season	---	182	144	20	0	346
		1993	Draw either-sex and Regular Non-trophy	na	302	403	85	0	790
		1992	Draw either-sex and Regular Non-trophy	na	172	258	74	3	507
		1991	Either-sex	na	193	239	129	6	567
		1990	Either-sex	na	328	112	29	0	469
		1989	Either-sex	na	223	84	17	2	326
		1988	Either-sex	na	186	97	13	0	296
		1987	Either-sex	na	132	106	14	0	252

Note: na = data not available

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